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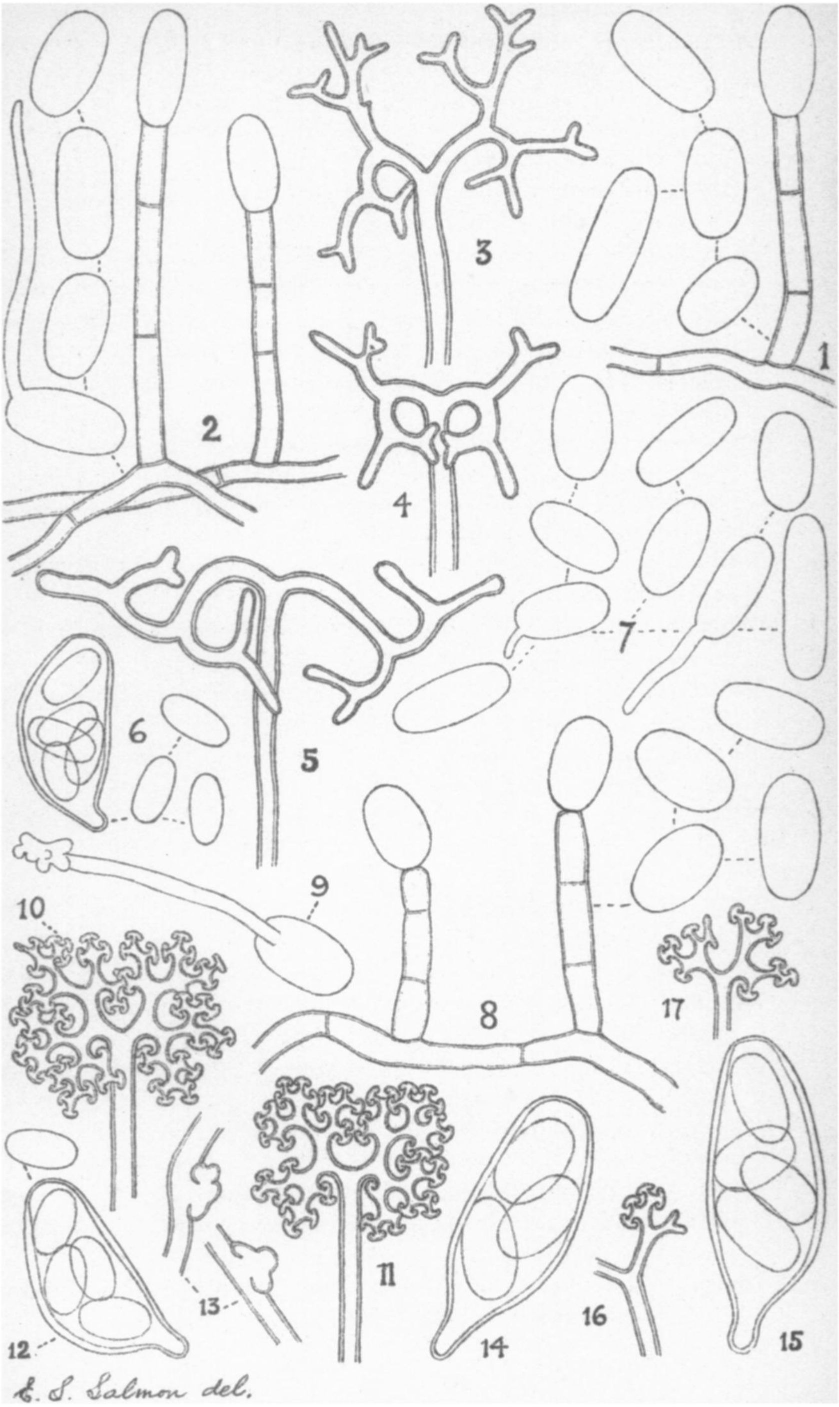

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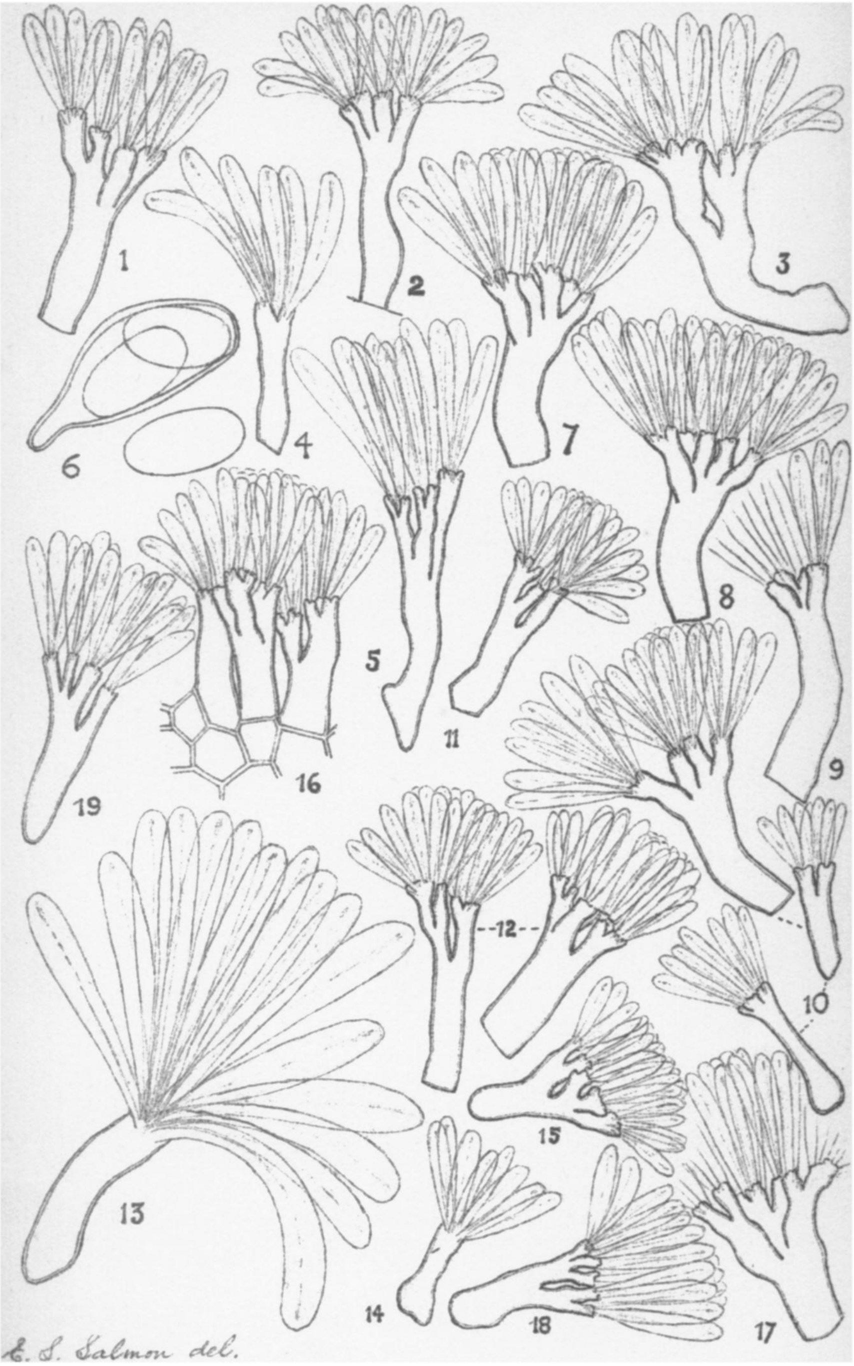

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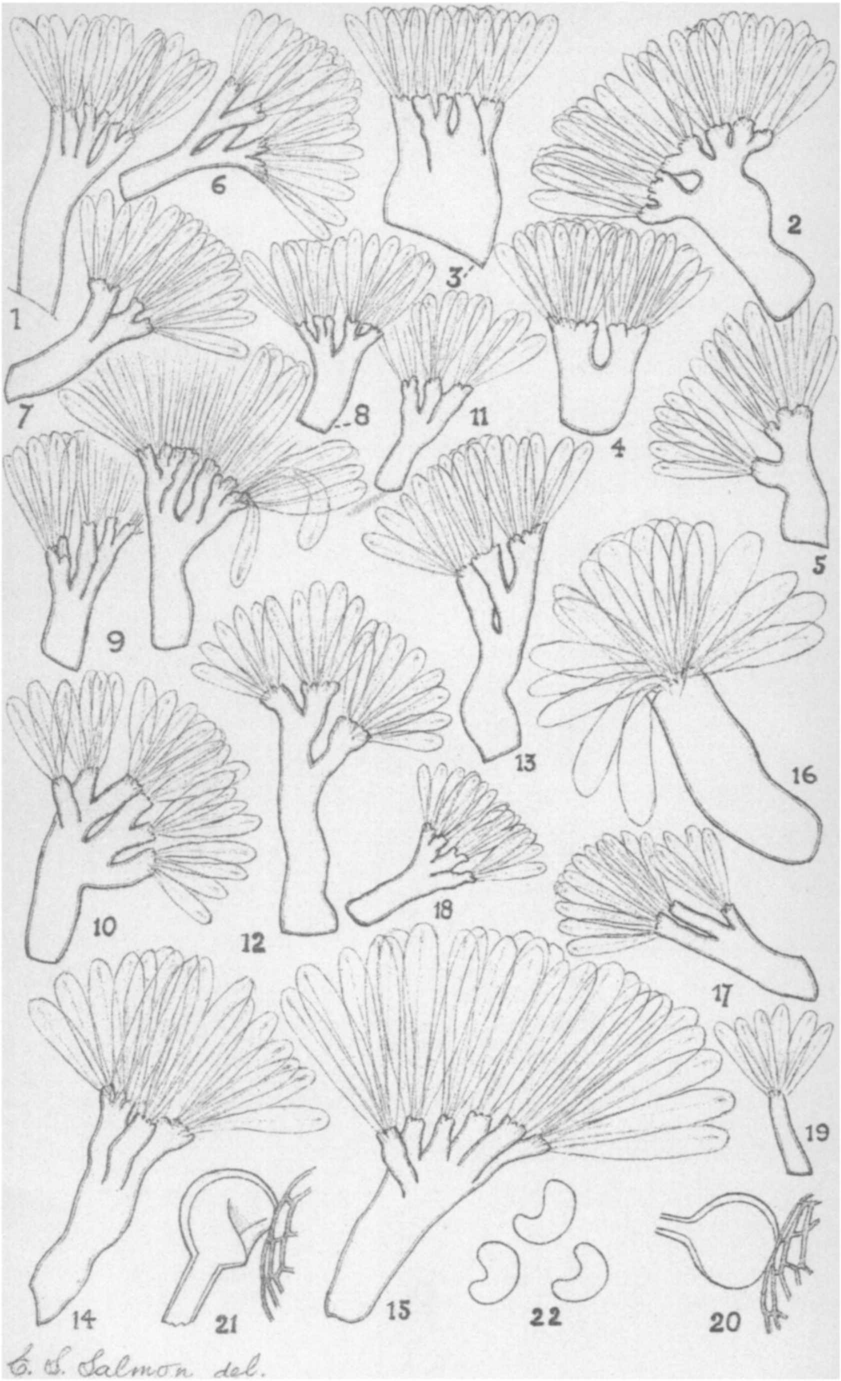

ERYSIPHACEAE.

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Supplementary Notes on the Erysiphaceae

BY E. S. SALMON, F.L.S.

(WITH PLATES 9–11)

(Continued from page 109)

ERYSIPHE POLYGONI DC. (Monograph, p. 174)

Syn. add: E. Fricki Neger, Bericht. Deutsch Bot. Gesellsch. **17**: (Generalversamm.-Heft) 241. 1899.

E. pisi DC. var. *desmodii* P. Henn. Engler's Bot. Jahrb. **29**: 148. 1900.

Conidial form : Oidium monosporum Passerini, Nuov. Giorn. Bot. Ital. **13**: 282. 1881.

Exsicc. add: * Rehm, Ascomycet. 1350 (sub *Microsphaera Caraganae* P. Magn.); * Krypt. Exsicc. (Mus. Pal. Vind.) 130, 131 (a & c only), 132.

Distrib. add: Europe: Faröe Islands (63), Bosnia (3), Bulgaria (10).

Asia: Siberia, Yeniseisk ("flum. Yenisei inter 58° et 71°") (A. Kitmanoff), Poseka, Wostotchnoje, & Nitchka (Sacc. in Malpighia, **10**: 269. 1896); Palestine (43).

South America: Argentine, "in alta Cordillera, 39° lat. merid. 900 m. supra mare (Neger).

Hosts, add: Aconitum variegatum (40), *Actinostemma racemosum*, *Anemone nemorosa* (40), *Aster* sp. (8), *Ballota nigra* (80), *Brassica oleracea* (13*), *Cytisus capitatus* (40), *C. purpureus* (40), *Delphinium hybridum* (cult.), *D. Maackianum* (cult.), *Desmodium podocarpum* var. *Japonicum*, *Dipsacus silvestris* (18), *Echinops* sp.

(29), *Geranium pratense* (18), *G. Robertianum* (6), *Geum Chiloense*, *Heuchera Americana* (84), *Hieracium umbellatum* (38), *Hypericum tetrapterum* (40), *Isopyrum thalictroides* (40), *Lathyrus Clymenum* (12), *L. montanus*, *L. niger* (40), *L. ochroleucus* (15), *L. palustris* (84), *L. venosus*, *L. vernus* (40), *Leonurus Cardiaca* (80), *Lupinus angustifolius*, *Lycopersicum esculentum* (13*), *Melampyrum silvaticum* (40), *Mentha arvensis* (80), *Myosotis* sp. (80), *Onobrychis Crista-galli* (43), *Papaver Rhoeas*, *Phaseolus vulgaris* (18), *Physalis* (29), *Pisum arvense* (18) (49), *Pleurospermum Uralense*, *Ranunculus nemorosus* (33), *R. recurvatus* (8) (84), *Rhabdosciadium Aucheri* (59), *Robinia Pseudacacia*, *Scabiosa stellata*, *S. succisa*, *Sedum Telephium* var. *purpureum* (cult.), *Sisymbrium officinale*, *Sium latifolium* (76), *Sonchus oleraceus* (80), *Thesium alpinum* (40), *Torilis Anthriscus* (40), *Trifolium agrarium*, *T. spadiceum* (40), *Urtica urens*, *Valeriana officinalis* (6), *Valerianella* sp. (80), *V. olitoria* (40), *Vicia tenuifolia* (40), *V. venosa* var. *capitata*.

I have received from Dr. Neger a specimen (now in the Kew Herbarium) of "*Erysiphe Fricki*," labeled "in foliis *Gei Chilensis* Balb. in alta Cordillera 39° lat. merid. 900 m. supra mare." I am quite unable to separate the fungus in any way from *E. polygoni*. The perithecia measure from 90–135 μ in diameter, and contain four to twelve 3–5-spored asci. The asci measure 65–70 × 34–40 μ (*pl. 1, f. 12*). Neger (**52**) gives the size of the asci as "55–65 × 28–35 μ," and states that *E. Fricki* differs from *E. Martii* (= *E. polygoni*) "durch beträchtlich grössere Schläuche (bei *E. Martii* nur 40–50 μ)." I have already pointed out, however (monograph, 178), that in *E. polygoni* the asci vary in size from 46–72 (very rarely reaching to 80 μ) × 30–45 μ. I have seen specimens of *E. polygoni* occurring on *Geum urbanum* in New Zealand.

Hennings (**31**) has described an *Erysiphe* from Japan as follows: "*E. pisi* DC. var. *desmodii*: amphigena, mycelio arachnoideo, tenui, effuso, albido; peritheciis gregariis vel sparsis, atris, globulosis, 80–100 μ, appendicibus hyalinis usque ad 100 μ longis 5–8 μ crassis; 3–4 ascis piriformibus, stipitatis, vertice rotundatis, 50–60 × 30–35 μ; 5–6 sporis ellipsoideis, 1–2-gutulatis, aurantio-oleosis, 17–19 × 14–12 μ. Prov. Musashi: Mt. Takao auf lebenden Blättern von *Desmodium polycarpum* DC. var. *latifolium* Max. (Kusano, no. 132, 18 October 1899)." Hennings remarks of

his plant: "Durch die askenärmeren Perithecien u.s.w. etwas verscheiden von der typischen Art." The character here specially mentioned—and indeed all those given in the diagnosis—are not important enough to separate the present plant even as a variety from *E. polygoni*, and are certainly not confined to the Japanese form, but occur on various hosts throughout Europe and North America. I have received, moreover, from Professor Kingo Miyabe a specimen labeled "*Ersyiphe polygoni* DC. (= *E. pisi* DC. var. *desmodii* P. Henn.). On *Amphicarpaea Edgeworthii* var. *Japonica* (not *Desmodium podocarpum*). Mt. Takao, Prov. Musashi, Oct. 8, 1899, (S. Kusano)." It would appear, therefore, that Hennings has founded his variety on the *Erysiphe* on *Amphicarpaea* This specimen sent by Professor Miyabe also cannot be separated in any way from *E. polygoni*. Professor Shotaro Hori has, however, sent me examples of *E. polygoni* on a host-plant which is certainly *Desmodium*, viz., *D. podocarpum* DC. var. *Japonicum* Maxim (Hakone, Prov. Sagami, Japan, coll. N. Nambu, Oct. 30, 1900). The occurrence of the present species on *Desmodium* is interesting, as hitherto the only mildew known on *Desmodium* (*D. Canadense*, *D. canescens*, *D. cuspidatum*, *D. paniculatum* and *D. sessilifolium*) was *Microsphaera diffusa* Cooke & Peck, which occurs not uncommonly in the United States, but which has not yet been recorded from elsewhere.

Magnus (Bericht. des naturwiss.-med. Ver. Innsbruck, **24**: 6. 1898), has recorded the occurrence of "*Sphaerotheca Castagnei* Lév." on leaves of *Caltha palustris*, from "Schruns in Vorarlberg (J. Bornmüller)." Through the kindness of Professor Magnus I have been able to see the original material on which the above record was based, and have found that the fungus in question is a small—or perhaps starved—form of *E. polygoni*, a species very common on many plants belonging to the Ranunculaceae (*Caltha*, *Clematis*, *Ranunculus*, *Aquilegia*, etc., etc.). This small form of *E. polygoni* is very likely to be mistaken for *S.* "*Castagnei*," and it may be well to point out here the distinguishing characters. In the first place, the appendages of this form of *E. polygoni* have the peculiar *facies* of those of the examples of this species occurring on *Clematis*, *Aquilegia*, *Ranunculus*, etc., and are fewer, longer, slightly wider (especially towards the base) and more distinct, and often more angularly bent, than the appendages of *S. "Castagnei."* On opening the perithecia, 2 to 4, or rarely 5, asci are found. In Professor Magnus's examples 2 to 3 was the usual number. Very rarely, apparently only a single ascus occurs, but as a rule a second ascus—often empty or more or less aborted—is to be found. In the rare cases in which only a single ascus is observable, this form of *E. polygoni* is easily separable from *S. "Castagnei,"* not only by the nature of its appendages, but also by the more or less ovate (not subglobose) ascus, containing (in this form) only 2–3 spores, and not 8 as in *Sphaerotheca.* Moreover, in all such cases, the examination of several perithecia invariably shows the existence in most of several (2 to 5) asci, and so leads us to conclude that the perithecia containing only a single ascus are ill-developed examples. Quite similar specimens of this small form of *E. polygoni* occur on species of *Geranium*, and have been commonly confused with *S. humuli.*

Brannon (8) has reported, in the case of examples of *Sphaerotheca* " *Castagnei* Lév." on a species of *Erigeron*, the finding of two or three perithecia, each containing two asci, and observes: " In these unusual forms one ascus was much larger than its companion, but not as large as the ascus existing alone in a perithecium. A few of these unusual forms might lead to the questioning of what has, heretofore, been considered a strong generic difference between *Sphaerotheca* and *Erysiphe.*" This occasional occurrence of more than one ascus has also been noted by other observers in species of *Sphaerotheca*; in two instances I have found perithecia of *S. mors-uvae* (Schwein.) Berk. & Curt. containing three asci (see monograph, 73). We see, therefore, that in rare instances *Sphaerotheca* may approach *Erysiphe* in possessing more than one ascus; on the other hand perithecia of the small form of *Erysiphe polygoni* on *Caltha palustris*, mentioned above, may very rarely contain only a single ascus. It is clear, therefore, that *Erysiphe* on one side shows an affinity with *Sphaerotheca;* on the other, through *E. tortilis* it claims relationship with *Microsphaera* through *M. astragali* and *M. Bäumleri.*

Brannon (8) has reported the occurrence of *E. polygoni* on a species of *Aster* and considers that this host had probably received the mildew from neighboring plants of *Ranunculus recurvatus* which were attacked by this species. Species of *Aster* are the common host-plants of *Erysiphe cichoracearum*. If the fungus has been correctly determined, the present instance is of great interest as showing that occasionally a species of mildew is able to pass directly on to the usual host-plants of another species (see p. 14).

In Journ. Myc. **5**: 83. 1899, Kelsey has recorded "*E. communis*" on *Vicia Americana* var. *linearis* (from Helena, Montana, U. S. A.). Specimens communicated to me by the author show that the fungus here recorded is *Microsphaera alni* var. *ludens*. Spegazzini (**79**) has recorded "*E. umbelliferarum*" on *Bowlesia tenera*, from the Argentine, but the fungus, from specimens communicated, proves to belong to *E. cichoracearum*. The *Erysiphe* recorded by Bubak (**9**) as "*E. communis*" on *Plantago major* is *E. cichoracearum*; specimens sent by the author are in the Kew herbarium. The fungus recorded by Saccardo in Rev. Myc. **11**: 41. 1881, as "*E. communis*" on "*Tragopogon* sp.," proves, according to a specimen sent, to be *E. cichoracearum*. The host-plant is not *Tragopogon*; Professor Saccardo, when sending the specimen, wrote on it "fol. *epilobii*," but the fragments sent were too small to admit of certain identification. Professor Saccardo also sent a specimen of the fungus recorded (Bull. Soc. Roy. Bot. Belg. **28**: 86. 1889, as "*E. Martii*" on *Pedicularis resupinata* from Siberia, and this proves to be *Sphaerotheca humuli* var. *fuliginea*. Tolf, in Bot. Notiser, 1891: 219, has recorded "*E. Martii*" on *Astragalus glycyphyllus* and *Vicia cassubica* from Sweden. According to specimens (now in the Kew herbarium) sent by the author, the fungus on the first-named host is *Microsphaera astragali*, and on the second, *M. Bäumleri*. The record by Freeman (**20**), of the occurrence of "*E. communis*" on *Eupatorium ageratoides* belongs to *E. galeopsidis* (see p. 194). Professor Oudemanns writes to me that his record (Rév. Champ. des Pays-Bas. **2**: 97. 1897), of "*E. communis*" on *Geranium molle* was based on the occurrence of merely an *Oidium* on this host, and that the record (*l. c.*) of the occurrence of the same species on *Verbascum Thapsus* was "borrowed from other writers." The fungus recorded by Rabenhorst (**59**) as "*E. Martii*" on *Alhagi maurorum*, *Vicia tenuifolia*, and *Rhabdosciadium Aucheri*, in Kurdistan most probably belongs to *E. taurica*. I have seen several examples of the latter species on the first two hosts, and there are specimens in the Kew Herbarium labelled "*E. communis leguminosarum.* Ad. *Vicia tenuifolia.* Professor C. Haussknecht, Iter orientale, 1868, Luristan," which belong to *E. taurica.* The fungus recorded by Feltgen (**18**) as "*E. Martii*" or *Lathyrus niger* proves, from specimens sent, to belong to the genus *Microsphaera* and is probably *M. Bäumleri* P. Magn. That, recorded by the same author (*l. c.*), as "*E. pisi*" on *Galium Aparine*, proved, like all records based on the fungus on species of *Galium*, to belong to *E. cichoracearum.* The host-plant given as *Colutea arborescens* by Sydow, in his Mycotheca Marchica, no. 980, was, as Magnus (**47***) has recently pointed out, wrongly determined and is really *Caragana arborescens. Colutea arborescens* must therefore be removed from the list of the host-plants of *E. polygoni.*

In 1870 de Bary (Beitr. Morph. Phys. Pilze, **1**: 50) raised the "*Erysiphe Martii* forma E." of Léveillé, occurring on various umbelliferous plants (see Lév. Ann. sci. nat. III. **15**: 166. 1851) to specific rank under the name *E. umbelliferarum*, and gave as host-plants *Angelica silvestris, Chaerophyllum hirsutum, Anthriscus silvestris, Pastinaca sativa, Falcaria Rivini* and *Heracleum Sphondylium.* De Bary stated that his species scarcely differed in perithecial characters from "*E. communis*," and remarked "Dagegen ist sie ausgezeichnet durch die Form der Conidien, welche genau walzenförmig, an beiden Enden flach, und mindestens (doch nicht immer) sehr langgestrecht sind. Bei den vorher genannten Arten allen haben die Conidien die (im Profil elliptische) Gestalt einer schmalen an den Enden abgerundeten Tonne." In my monograph (p. 184) I remarked that this character could hardly be considered sufficient to separate "*E. umbelliferarum*" as a species, and also doubted whether it were a constant and distinctive feature of the *Erysiphe* on Umbelliferae. I have since studied in a living state some conidial forms of *E. polygoni*, and have found that the shape of the conidium is extremely variable. On *Sisymbrium Alliaria* (Cruciferae) (*pl. 9, f. 7*) the conidia are for the most part distinctly cylindrical in shape, and intermixed with them one finds quite commonly elliptical conidia. The size of the conidium varies greatly ; the cylindrical ones are usually about 38 μ long (and about 15 μ wide), but here and there a conidium occurs which measures over 50 μ long; the elliptical conidia measure 30–33 × 17–19 μ. On *Heracleum Sphondylium* (Umbelliferae) (*pl. 9, f. 2*) elliptical conidia are of quite common occurrence; considerable variation in size is found also here. On *Anthriscus sylvestris* (Umbelliferae) (*pl. 9, f. 1*) most of the conidia are cylindrical, but occasionally elliptical ones occur. Also, in examples on *Delphinium hybridum*, *D. elatum*, and *D. Maackianum* (Ranunculaceae) (*pl. 9, f. 9*) the shape of the conidia varies from elliptical to cylindrical. The reduction of "*E. umbelliferarum*" to *E. polygoni* appears therefore fully warranted.

It may be here pointed out that, as *f.* 1, 2, and 8 on *pl. 9* show, the conidiophores of *E. polygoni* bear only a single conidium at the apex, unlike the *Oidium* form of many mildews, where the conidia are concatenate in long chains (see monograph *f. 127* for that of *E. galeopsidis*, and *f. 140* for that of *E. cichoracearum*; see also *f. 115*, *117*, and *156*). It would be interesting to ascertain if this feature is characteristic of *E. polygoni*, as if so it might be of use in distinguishing the species in its conidial condition.

In connection with the fact mentioned above of the conidiophores of *E. polygoni* bearing only a single spore, we may note that Passerini has published the following description of a fungus (Nuov. Giorn. Bot. Ital. **13**: 282. 1881): "*Oidium monosporum* Passer. hb. Epiphyllum, maculas discoideas pulveraceo-cinereas demum fuscas efformans. Hyphae longae, subclavatae, articulatae, in sporam unicam oblongo-ellipticam desinentes. An *Ovulariae* Sacc. Michel. **6**: 17, analogum?—Sulle foglie della *Robinia hispida* L. nel R. Orto Botanico, Luglio." Professor C. Avetta has kindly sent me the type-specimens of "*O. monosporum*" from Passerini's herbarium at Parma University, and examination of this has convinced me that the fungus described is merely the conidial stage of *E. polygoni*. The subcylindrical conidia measure from 28–40 μ long × 13–16 μ wide. *E. polygoni* is known to occur on other species of *Robinia* (*R. Pseudacacia* and *R. viscosa*).

In germinating some conidia of *E. polygoni* on *Delphinium Maackianum* in a hanging drop of water, several cases were observed of the formation of lobed "appressoria" at the places where the tips of the germ-tubes had come into contact with the cover-glass (see *pl. 9, f. 9*). No formation of haustoria proceeding from these was observed. This phenomenon was first noticed by Büsgen (**11**), who remarks of the germinal hyphae proceeding from conidia of *E. polygoni* sown in the same way: "bei Berührung mit dem Objectträger erzeugten sie lappige Appressorien, mit deren Bildung ihr Wachsthum abgeschlossen war. Ein Austreiben der Appressorien fand nicht statt, obwohl der Inhalt der Gonidien noch nicht erschöpft schien. Es darf daraus geschlossen werden, dass auch bei den Erysipheen zur Entwickelung des Infectionsfadens ein Ernährungsreiz nothwendigist, der in der Natur nur von der Wirthspflanze ausgehen kann."

In the Journal of the Royal Horticultural Society (London) for 1900 (**35**) it is reported that the prevalence in autumn, in some parts of Britain, of the "pea-mildew" (*E. polygoni*), is causing the cultivation of late varieties of peas to be abandoned. A similar state of affairs has already been recorded in the western United States by Bessey (Seventh Biennial Report Iowa Agric. Coll., 1877). Dusting the infected plants over with flowers of sulphur (mixed with air-slacked lime), or spraying with a solution made by dissolving 3 oz. of carbonate of copper in 2 quarts of aqua ammonia diluted to 22 gallons, is stated to be the best means of combating the disease. (See Galloway, on the "Powdery Mildew of the Bean," Journ. Myc. **5**: 214. 1889.) Lodeman (**40***, p. 325) writes of the "Pea Mildew": "This disease could undoubtedly be easily checked by means of the copper sprays, but the foliage of these plants is of such a character that liquids do not readily adhere. Soap will assist in overcoming this difficulty if it is added to the liquids. Another line of treatment which might be followed by good results is to apply powder to the vines while they are wet with dew. Fostite should prove of value for this purpose."

In 1891 Comes (**13***) described under the name *Oidium ceratoniae* a mildew which had been observed for several years previously on the carob-tree (*Ceratonia Siliqua*) in southern Italy. This fungus is stated to attack by preference the younger leaflets, which become deformed and fall off, the young shoots, and the immature fruits. When the mildew appears at the time of flowering, fertilization fails—if afterwards, the young fruit does not fall, but usually becomes more or less atrophied or withered on the plant, and is always depreciated in quality. The mildew appears to be more prevalent in wet than in dry years, and is found more in localities in which water remains at the foot of the plant than in those in which the soil being permeable leaves the stock free from water. The disease always begins on trees which have their roots more or less affected and made rotten by stagnant water, and then spreads from these plants radially as from so many centers of infection. The means adopted of dealing with the disease is to bare the roots of the trees most seriously attacked, and to cut off those roots which are more or less rotten; and further to keep the soil soft and permeable at the foot of the trees by burying there faggots or straw. Cutting off the tops of diseased branches is also recommended.

Grimaldi (Come fare fruttificare abbondantemente il carrubio, Palermo, 1895) also reports that the present fungus seriously affects in some seasons the harvest of carob-beans (St. John's bread), and states that the disease is popularly known as "a farinedda."

Although no perithecia were observed on the carob trees affected, Comes referred his "*O. ceratoniae*" to *Phyllactinia corylea*, considering it to be the conidial stage of that species.

In 1899 I received from Professor P. Gennardius, Director of Agriculture, at Nicosia, Cyprus, some diseased pods of *Ceratonia Siliqua*, which on examination were found to be covered with a mildew. The fungus, which was stated to cause great damage to the carob crop in Cyprus in some seasons, is evidently the "*Oidium ceratoniae*" of Comes; it shows, however, all the characters of the conidial stage of *E. polygoni.* The presence of ordinary haustoria on the mycelium proves conclusively that the fungus is not to be referred to *Phyllactinia.* Specimens of "*O. ceratoniae*" have been issued in Briosa e. Cavarra, Fung. par. no. 238, from Sicily, where the fungus is stated to have seriously affected the harvest of carob-beans in 1892. The figures here given represent fairly well the conidial stage of *E. polygoni.* The conidia are described as cylindrical (truncate at the ends) and measuring 26–36 × 12–14 μ, and are stated to differ from those of "*O. erysiphoides*" in the wall being somewhat rough ("alquanto verrucosa"). The conidia I have seen measure about 30–35 × 12–15 μ, and have a smooth wall, although, as is generally the case with the conidia of the Erysiphaceae, very old conidia, through the wrinkling of the cell-wall, or through incrustation, appear falsely to be rough.

The fungicides, recommended for the "pea mildew" above, should prove efficacious here.

Comes (**13***, p. 246) also records cases of the tomato being seriously affected by the present species, and remarks, "In 1879 the tomato was attacked by it at Palermo. The plants presented grayish spots, which by degrees became black, both on the skin and on the leaves. Microscopic examination showed the presence of an *Erysiphe*, very similar to the preceding [*E. Martii*], but furnished with the characters of *E. communis.* In 1881 it injured the tomatoes in the region of Salerno, and in other localities of northern and central Italy. Moreover, this disease has been known in the region of Palermo for twenty-five to thirty years under the name of *male nero ;* it attacks the plant at all seasons, but more readily about the beginning of May. The cultivators think that it is caused by excessive dampness, since the plant, cultivated under dry conditions, is exempt from it. They are convinced that the disease is contagious, and consequently if they observe that the disease appears in a nursery they destroy the affected plants immediately. They hold that sulphuring alone is useless ; they are accustomed, instead, to cut back the plants, to leave them dry, and then to sulphur them. When the disease appears before or at the commencement of flowering, they prefer to destroy the affected plants." Tomaro (Le due crittogame che maggiormente danneggiano i pomidori ; *cf.* Just's Bot. Jahresber. 1891, **2** : 245, 1893), has also reported the occurrence of "*E. communis*" on the tomato in the neighborhood of Bergamo, and states that the disease was induced by excessive moisture.

Var. SEPULTA (Ell. & Everh.) Salm. (Monograph, p. 191)

Distrib. add: United States of America, California, 7,000′ (A. Purpus) in herb. Jaczewski.

E. CICHORACEARUM DC. (Monograph, p. 193)

Exsicc. add: * Rehm, Ascomycet. 1199; & 1298 sub *E. Martii* Lév. f. *rubiacearum;* Krieg. Fung. saxon. 1218, 1219 1220, 1221 (in herb. Jaczewski).

Distrib. add: Europe: Bosnia, Bulgaria (10), Dalmatia (3).

Asia: Siberia, Yeniseisk, "flum. Yenisei inter 58° et 71°" (A. Kitmanoff), Transcaucasia, Lencoran (59); Turkestan, Taschkent, Tschïmkent (79*).

South America: Argentine Republic, "Puente de Inca, Audibus Mendozinis" (C. Spegazzini, May 3, 1901), Flores no. Buenos Aires, Nov. 20, 1888 (C. Spegazzini), Lincoln (79).

Hosts, add: Artemisia serrata (23**), *Aster azureus* (84), *A. lateriflorus* (17), *A. Novae-Angliae* (84), *A. undulatus* (8), *Bidens bipinnata* (79), *Bowlesia tenera*, *Calendula arvensis* (40), *C. fulgens* (40), *Centaurea Cyanus* (40), *C. pectinata*, *Cineraria* sp. (75), *Cnicus arvensis*, *Echinospermum Lappula* (6), *Echium vulgare*, *Eupatorium ageratoides* (15), *Euphorbia* sp., *Helianthus parviflorus* (84), *Hieracium umbellatum* (76), *Hydrophyllum appendiculatum* (84), *H. macrophyllum* (84), *Inula Britannica*, *Myosotis* sp. (3), *M. collina* (40), *M. palustris* (40), *M. sparsiflora* (40), *M. stricta* (40), *Parietaria Canadensis* (84), *P. judaica* (40), *Phlomis Herba-venti* (80), *Physalis Alkekengi*, *Pilea pumila* (84), *Plantago Cornopus* (38), *Salvia glutinosa* (66), *Senecio erucifolius* (34), *S. Fuchsii*, *S. silvaticus* (40), *S. viscosus* (40), *Solidago latifolia* (84), *Symphytum tauricum*, *Verbascum Lychnitis*, *Willughbya scandens* (17), *Zinnia elegans* (84).

A very interesting form (now in the Kew herbarium) has been sent to me by Dr. Spegazzini labelled "*E. andicola* Speg. n. sp. Puente de Inca, Audibus Mendozinis, May 3, 1901. In *Euphorbia* sp." The perithecia measure up to 180 μ in diameter, although most of them are smaller, being of the size, normal for *E. cichoracearum*, the asci measures from 70–85 x 25–30 μ, and the spores up to 28 μ long, although the latter are usually smaller (about 25 μ long). This South American example on *Euphorbia* matches exactly, in the persistent mycelium and the occasionally large size of the perithecium and asci, two North American forms of *E. cichoracearum*,—one on *Lygodesmia juncea*, from Helena, Montana, U. S. A. (Kelsey, September 15, 1890)—the other on *Bige-*

lovia—on *B. viscidiflora* (*B. Douglasii*), Willis, Montana, U. S. A. (F. W. Anderson, Oct. 1888), and on *Bigelovia* sp., Laramie Hills, Wyoming (E. Nelson, September 28, 1897). I have already remarked on the peculiarities of the form on *Bigelovia* (see monograph, p. 203). This South American plant on *Euphorbia*, while much recalling the Old World species *E. taurica* Lév. in habitat, and in the large size of some of the perithecia and asci, yet clearly belongs to *E. cichoracearum*, and exactly matches the large form of this species found on *Arctium* in Europe.

The fungus recorded by Hennings (**30**) as "*E. lamprocarpa*" on *Bigelovia* sp. from "Snow Mount, 7,000 ft., California" is according to a specimen collected by Purpus and labelled "California 7,000 ft." (in herb. Jaczewski) *E. polygoni* var. *sepulta.*

Spegazzini (**79**) has recorded "*E. umbelliferarum*" (= *E. polygoni*) on *Bowlesia tenera* from Flores near Buenos Aires, and in the diagnosis has described the spores as measuring 25–40 μ long × 14–18 μ diam." Professor Spegazzini has sent me a specimen of the plant (labelled "*E. umbelliferarum* var. *platensis*"), which proves to be *E. cichoracearum.* The few spores seen by me measured about 24 × 14 μ. The fungus recorded by Spegazzini (**79**) as "*E. lamprocarpa*" on *Tagetes glandulifera* proves to belong to *E. galeopsidis.*

The records by Bubak (**10**) of *E. cichoracearum* on *Verbascum phlomoides* and *V. Lychnitis* (and probably also that on *V. Blattaria*) from Bulgaria belong to *E. taurica.* Professor Oudemanns writes to me that his record (Rév. Champ. des Pays-Bas, **2**: 94. 1897) of "*E. lamprocarpa*" on *Verbascum thapsiforme* was based merely on the occurrence of an *Oidium* stage on this plant.

I have stated in my monograph (p. 202) that the *Erysiphe* occurring on *Echium* and *Anchusa*, although commonly referred to *E. cichoracearum*, has always proved in my experience to be *E. polygoni.* I have, however, since found in Professor Jaczewski's herbarium, a specimen on *Echium vulgare* ("St. Lubin-de-la-Haye, Eure-et-Loire, France") which is true *E. cichoracearum* (with regularly 2-spored asci, etc.). On *Anchusa*, however, the fungus in all the examples I have seen, belongs to *E. polygoni*—good specimens on this host are to be found in Syd. Myc. March, no. 655.

The fungus recorded by Raciborski (**60**) as *Oidium tabaci* from Java is probably the conidial stage of *E. cichoracearum.*

Examples of the form of *E. cichoracearum* (on *Galium*) with perithecia containing asci without any trace of spores (see monograph, p. 208) occur in the Paris Museum, labelled "*E. Martii* Lév. sur *Galium.* Souk el Arba [Algeria]. 1er Janvier 1893."

As *E. cichoracearum* frequently proves a serious enemy to cucumber culture—more especially to cucumbers forced in the greenhouse for a winter crop—the following notes on the successful treatment of the disease may be given. Humphrey (**31***) states: "The disease may be kept in check in the greenhouse by spraying the plants as often as is necessary with a solution of sulphide of potassium (liver of sulphur) in water, an ounce of the sulphide to four gallons of water. A stronger solution injures the plants and fruits. Spraying with ammoniacal carbonate of copper (3 oz. carbonate of copper dissolved in one quart of ammonia; dilute with water to 25 gallons) has been found even more effective. But Professor Bailey finds more effective than either exposure to sulphur vapor. This is accomplished by closing the house as tightly as possible for half an hour or an hour at a time, while it is filled by the vapor arising from a vessel of sulphur kept a little above the melting point on a small oil stove. The vessel should be porcelain-lined, to protect the iron from the action of the sulphur. Great care must be taken to avoid the ignition of the sulphur." It may be noted that Humphrey found that the conidia of *E. cichoracearum* on cucumber leaves differed considerably in size in examples from different localities.

Stewart (**81**) records cases of field-grown cucumbers thickly covered with mildew. (See also for "Cucumber mildew," Bailey (**2***).)

Oidium chrysanthemi Rabenh. Hedwigia, **1**: 19–21. *pl. 3. f. 1.* 1853, is probably the conidial stage of *E. cichoracearum,* and is frequently very troublesome on cultivated chrysanthemums. The fungicides recommended above should be used to check the disease.

E. GALEOPSIDIS DC. (Monograph, p. 204)

Distrib. add: Europe: Bulgaria (10).

Asia: Siberia, Yeniseisk, "flum. Yenisei inter 58° et 71°"

(A. Kitmanoff), Minussinsk (Martianoff), Monastir, Poseka, and Lake Karasin (Saccardo, Malpighia, **10** : 269. 1896).

South America: Argentine Republic, Lincoln (Spegazzini, Sept. 1899).

Hosts, add: Calamintha Acinos (40), *Galeopsis Ladanum* (18) (40), *Lamium amplexicaule, Phlomis tuberosa, Salvia officinalis* (34), *Scutellaria lateriflora* (84), *S. pilosa* (84), *Tagetes minuta, Teucrium Scorodonia.*

Freeman (**20**) has recorded "*E. communis*" on *Eupatorium ageratoides* L. (Hennepin, Oct. 1893. Sheldon 4083). The author kindly sent me part of the original material (now in the Kew herbarium), and I have found that the fungus is the *Erysiphe* with lobed haustoria which I have referred at p. 208 of my monograph with some doubt to *E. galeopsidis.* In the present case, as in the two other examples mentioned in my monograph (*l. c.*), the asci agree with those of *E. galeopsidis* in not containing spores on the living plant. *E. cichoracearum* with normal bisporous asci occurs on *Eupatorium cannabinum, E. perfoliatum,* and *E. purpureum,* and it is certainly very interesting to find on one species of the genus, viz.: *E. ageratoides,* a fungus constantly possessing lobed haustoria and asci without spores—a combination of characters only found in *E. galeopsidis.*

Professor Spegazzini has sent me a specimen (now in the Kew herbarium) of the *Erysiphe* recorded (79) by him as "*E. lamprocarpa* (Wallr.) Lév." on *Tagetes glandulifera* (= *T. minuta*) from Lincoln, Argentine Republic, Sept., 1899. On examining this fungus I found that the asci, although the perithecia in color, etc., appeared ripe, contained no spores, and on searching the mycelium for haustoria it was found that these were, for the most part at any rate, distinctly lobed (see *pl. 9, f. 13*). The fungus consequently must be referred to *E. galeopsidis.* The host-plant in the above case belongs to the Compositae and on this account the record is of special interest. *E. galeopsidis* had been supposed to be confined in its range of host-plants to genera belonging to the Labiatae and to *Chelone* in the Scrophulariaceae until the existence of an *Erysiphe* with lobed haustoria and asci without spores was discovered on *Eupatorium ageratoides* (see paragraph above). We have now an instance of the occurrence in South America of the same fungus on another genus of Compositae.

The fungus recorded by Bubak (**10**) as *E. galeopsidis* on *Marrubium peregrinum* from Bulgaria belongs to *E. taurica.*

Atkinson (Journ. Elisha Mitch. Sci. Soc. **10** : 75. 1894), has recorded *E. galeopsidis* from Alabama, U. S. A., " on *Verbena urticifolia,* October 23, 1891 (coll. B. M. Duggar)." Specimens (now in the Kew herb.) kindly sent to me by the author prove, however, that a wrong identification of the fungus has been made, the species being clearly *E. cichoracearum* DC., as is shown by the asci containing two or rarely three spores on the living host-plant and by the absence of lobed haustoria on the mycelium.

E. GRAMINIS DC. (Monograph, p. 209)

Ascigerous form.

Exsicc. add: *Linhart Fung. hungar. 80; Krieg, Fung. saxon. 1216, 1217 (in herb. Jaczewski).

Distrib. add: Europe : Faeröe Islands (63).

North America : United States, Indiana (84) ; East Greenland (Rostrup, Meddel. om Groenland, **18** : 61. 1896.

Australasia : Tasmania (62).

Hosts, add: Bromus mollis, Catabrosa aquatica (40), *Holcus lanatus* (13), *Lolium perenne* (38), *Milium effusum* (76), *Poa alpina* (40).

Conidial form.

Syn. add: Oidium tritici M. A. Libert, Pl. Crypt. Ard. fasc. IV, no. 385 (cum diag.) 1837; Sacc. Syll. Fung. **4** : 46. 1886.

Torula tritici (Lib.) Corda, Ic. Fung. **5** : 51. *pl. 2. f. 15.* 1842.

Torula bulbigera Bonorden, Bot. Zeitung, **19** : 195, *pl. 8. f. 8.* 1861.

Oidium bulbigerum (Bon.) Sacc. & Vogl.; Sacc. Syll. Fung. **4** : 47. 1886.

Torula rubella Bonorden, Bot. Zeitung **19** : 195. 1861.

Oidium rubellum (Bon.) Sacc. & Vogl.; Sacc. Syll. Fung. **4** : 46. 1886.

Exsicc. add: Lib. Pl. Crypt. Ard. fasc. IV, no. 385; Fckl. Fung. Rhen. 72; Jack, Leiner u. Stizenb. Krypt. Bad. 819; Rab. Fung. Eur. 477; Klotzsch, Herb. myc. ed. nov. 81; de Thüm. fung. austr. 541.

(*T. rubella*) Rab. Fung. Eur. 281.

Libert gives the following diagnosis of *Oidium tritici*: "Epiphyllum, caespitibus oblongis confluentibus fulvis; floccis simplicibus erectis in articulos pellucidos ovales secedentibus. Ad folia viva *Trictici repentis*, Aestate." Examination of the specimen of *O. tritici* in Lib. Pl. Crypt. Ard. fasc. IV, no. 385 shows that the fungus is identical with *Oidium monilioides* Link., the conidial stage of *E. graminis*. The bulbiform swelling at the base of the conidiophore seems a constant feature in the conidial stage of *E. graminis* (see monograph, *pl. 9. f. 156*; and also Garovaglio & Cattaneo, Archiv. Lab. Bot. Critt. Univ. Pavia, 2: *pl. 2.* 1879), and was observed in all the specimens in the exsiccati of "*O. trictici*" quoted above.

Bonorden founded his "*Torula bulbigera*" on Rabenh. Fung. Europ. Cent. II. no. 275, and published the following diagnosis: "Sporis ovatis s. oblongo-ovatis 4–6 concatenatis hyalinis albis, hyphis (pedicellis) triseptatis, basi bulbosis; mycelio ramoso, septato et repente. Hab. in foliis graminum in Guestphalia." From the description and figures given there can be no doubt that "*Torula bulbigera*" is nothing more than *Oidium monilioides*. The inflated base of the conidiophore, relied upon by Bonorden as the chief specific character, is, as has been pointed out above, a constant feature in the conidial form of *E. graminis*. I have not seen Rabenb. Fung. Eur. no. 275.

Torula rubella Bonorden was founded on Rabenh. Fung. Eur. Cent. III. no. 281, and the following diagnosis given: "Sporis ovoideis 3–4 concatenatis; pedicellis articulato-septatis, rubicundis subrubiginosis. Hab. in foliis vivis graminum in Guestphalia." This also proves to be the conidial stage of *E. graminis*. In Rab. Fung. Eur. no. 281, the "*Torula*" can be seen passing over into pannose mycelium in which perithecia of *E. graminis* are immersed. The bulbiform swelling at the base of the conidiophore is present in these examples, just as in "*T. bulbigera*" (see above).

Spegazzini (79) records "*Oidium monilioides*" on *Bromus unioloides* and *Avena sativa*, in the "Parque de La Plata, winter 1882–95." Nees (Syst. Pilze u. Schwämme, 53. 1817) records a fungus under the same name from Germany on *Dinebra Arabica* (cult.).

The haustoria of *E. graminis* are peculiar in possessing long finger-like processes. They have been studied in detail by Grant Smith (**77**), and well figured. (See p. 4.)

E. TORTILIS (Wallr.) Fr. (Monograph, p. 213)

Syn. add: Trichocladia tortilis (Wallr.) Neger, Flora, **88** : 351. 1901.

Distrib. add: Bulgaria (10).

The record of the occurrence of *E. tortilis* on *Thalictrum aquilegifolium* by Massalongo (**50**) was due to an error of identification, the fungus in specimens sent to me proving to be *E. polygoni* DC. Professor Oudemanns writes to me, with regard to his record (Rév. Champ. des Pays-Bas, **2** : 95. 1897) of *E. tortilis* on *Cornus alba*, that "the leaves of the *Cornus*, examined with more care, prove not to belong to *C. alba*, but to another garden species, unable to be identified."

E. TAURICA Lév. (Monograph, p. 215)

Distrib. add: Bulgaria.

Hosts, add: Cerinthe (80), *Dorycnium herbaceum* (80), *Marrubium peregrinum*, *Saussurea* sp., *Verbascum Lychnitis*.

The example on *Marrubium peregrinum* from Bulgaria is recorded by Bubak (**10**) as *E. galeopsidis*, but from a specimen (now in the Kew herbarium) sent by the author the fungus proves to be *E. taurica*. Similarly, the fungus on *Verbascum phlomoides* and *V. Lychnitis*, referred by the same author to *E. cichoracearum* proves, from specimens sent (now in the Kew herbarium) to belong to *E. taurica*. The same is also probably the case with the fungus on *V. Blattaria*, referred also to *E. cichoracearum*, but the specimen sent is too immature to permit of certain identification, although the habit is that of *E. taurica*. The record by Brunaud (Actes Soc. Linn. Bordeaux, **32** : 155. 1878) of the occurrence of *E. taurica* on *Cnicus lanceolatus* from France proves to be erroneous, the fungus proving, from a specimen sent (now in the Kew herbarium), to be *E. cichoracearum*. Dr. Hennings has sent me from Rabenhorst's herbarium a specimen of the fungus recorded (**59**) as *Sphaerotheca Castagnei* Lév. on *Euphorbia* "am Berge Kellal in Sud-Persien, 10,000′ s. m." The species proves to be *E. taurica*. Another specimen sent from Rabenhorst's herbarium is the fungus which has been recorded (**59**) as *S. Castagnei* on *Hibiscus esculentus.* This bears no perithecia, but from the mycelial characters shown probably belongs to *E. taurica.*

Oidium haplophyllii P. Magnus (**43**) on *Ruta* (*Haplophyllum*) *Buxbaumii*, from Palestine, is probably the conidial condition of *E. taurica.*

Through the kindness of M. P. Hariot I have seen the specimens, in the Paris Museum, of the fungus recorded by Léveillé (Ann. sci. nat. III. **15**: 161. 1851) as "*E. taurica.* On *Aplotaxis*, Himalaya (Jacquemont. Herb. Par.)." The fungus belongs as named, to the present species, and is growing on some species of *Saussurea* (*Aplotaxis*). The specimens are labelled "*Erysiphe compositarum* Lk.—in fol. *Aplotaxis.* Indes orientales, Jacquemont."

Speschnew (**79***) has lately published as new species of *Erysiphe* two plants occurring in Turkestan on *Euphorbia lanata* and *Acanthophyllum glandulosum.* The following descriptions are given: "*E. euphorbiae* (sp. nov.) N. Speschnew. Mycelio epiphyllo, interdum hypophyllo, constricte effuso, confluente, tenui; hyphis repentibus, ramosis, flexilibus, undulatis, septatis, dense intertextis, crassiusculis, hyalinis, $4,_{9}$–$7,_{4}$ μ crass.; hypopodiis biclavatis, alternis, ca $14,_{8}$–$22,_{5}$ μ; peritheciis gregariis, globosis, dein subglobosis, in villo nidulantibus, 150–180 μ diam., atrobrunneis, setulis hyalinis, aseptatis, anucleatis, undulatis, apice pedaliformibus, 7–9 μ crassis, perithecio duplo longioribus; ascis elongato-piriformibus, de medio attritis, apice obtusis, operculatis, 3–6-sporis, 90–98 × 22–24 μ; sporis ellipsoideis, continuis, aseptatis, hyalinis, 20–24 × 11–15 μ; hyphis conidii feris illis mycelii similibus, conidiis elongato-ovoideis, mediocre cuncatis, 20–24 × 12–16 μ, episporio valde crasso, 2–3 μ. Habitat in foliis *Euphorbiae lanatae* Sisb. Primo leg. auct. prope Taschkent, 22, ix, 1898. *E. acanthophylli* (sp. nov.) N. Speschnew. Mycelio hypophyllo; hyphis tenuibus, non constringentibus, ramosis vel simplicibus, septatis, valde undulatis, achrois, granulatis, $1,_{5}$–2 μ crassis; hypopodiis nodosis, bifurcatis; peritheciis epiphyllis, solitariis, sparsis, haud immersis, globosis vel subglobosis, ca 160 μ diam., atris; setulis rectis, continuis, nucleatis, apice rotundatis, 2–3 μ crassis; ascis late piriformibus, 8-sporis, 38 × 28 μ; ascosporis subsphaericis, continuis, aseptatis, hyalinis, ca 8 μ diam.; hyphis conidiiferis illis mycelii similibus, conidiis elongato-ovoideis, ca 38–43 x 16–19 μ, episporio tenuissimo. Habitat in foliis cauleque *Acanthophylli glandulosi* Bg. Taschkent, Bukhara, Tschardjui, 27, ix, 1898."

The original Latin diagnoses given by Speschnew are rendered somewhat obscure by faulty construction. As far as possible I have corrected the mistakes in the diagnoses given above. From the description and figures given by Speschnew I am strongly inclined to think that both "*E. euphorbiae*" and "*E. acanthophylli*" are to be referred to *E. taurica*, notwithstanding the fact that Speschnew gives the number of spores in the ascus as 3–6 in "*E. euphorbiae*" and 8 in *E. acanthophylli*, while in *E. taurica*, in my experience, the asci contain when ripe only two spores. It is to be noted, however, that the young asci of *E. taurica* frequently contain one or two, or more, drops of oily matter, which much resemble immature spores. From the figures given by Speschnew, I am inclined to think that this author had under observation immature asci containing young spores and oily globules. The mistake of describing these oily globules as spores has apparently somewhat frequently occurred. "*Erysiphe lanuginosa*" (= *E. taurica*) on *Daucus maximus*, from Greece, was described by Fuckel (Bot. Zeitung, **29**: 27. 1871), as possessing 8–12-spored asci, but in the examination of authentic specimens I have found the asci constantly bisporous. Two plants from Persia, in all probability the same as those found by Speschnew, have been described by Magnus as "*Erysiphe lanata*" on *Euphorbia lanata* and "*Microsphaera Bornmuelleriana*" on *Acanthophyllum glandulosum*, both of which I have referred at p. 218 of my monograph to *E. taurica*. The asci of "*E. lanata*" were described as containing 3–5 spores and those of "*M. Bornmuelleriana*" 4–6 spores. In specimens of these plants from Magnus' herbarium, however, I have been able to find in the ripe ascus only two spores. It is, however, quite possible that forms of *E. taurica* may occur with occasionally 3 or 4 spores in the ascus, for we must remember that this is the case with several species which are typically bisporous, *e. g.*, *E. cichoracearum* DC., *Uncinula clandestina* (Biv. Bern.) Schroet., *U. polychaeta* (Berk. & Curt.) Ellis, and *Phyllactinia corylea* (Pers.) Karst.

E. AGGREGATA (Peck) Farl. (Monograph, p. 221)

Exsicc. add: Shear, New York Fungi 147 (in herb. Jaczewski).

Distrib. add: Wisconsin (15).

Freeman (**20**) has reported the occurrence, from Minnesota, U. S. A., of the present species on the leaves of *Alnus incana*. The author has since written to me, however, that this record is a mistake, the habitat being, as is invariably the case, the cones of the *Alnus*.

PHYLLACTINIA CORYLEA (Pers.) Karst. (Monograph, p. 224)

Syn. add: Erysiphe stellata and vars. *coryli* and *alni* L. Marchand, Bijdr. tot de Natuurk. Wetensch. (Amsterdam), **4**: 272. 1829.

E. fungicola Schulz. Oest. Bot. Zeit. **26**: 58. 1876.

Phyllactinia fungicola (Schulz.) Hazslinszky, M. Tud. Akad. Math. és Természettud. Közleményck, **14**: 181. 1876–77.

? *P. fungicola* (Schulz.) Saccardo, Syll. Fung. **1** : 6. 1882.

P. clavariaeformis Neger, Bot. Centralbl. **80**: 11. 1899; Neger, Ber. Deutsch. Bot. Gesellsch. **17**: 235. 1899.

P. suffulta (Reb.) Sacc. var. *moricola* P. Henn. Engler's Bot. Jahrb. **28** : 271. 1900.

Excicc. add: * Ell. & Everh. Fung. Columb. 108 (b); * Krieg. Fung. saxon. 1226; * Krypt. exsicc. (Mus. Pal. Vind.) 120; * D. Sacc. Myc. Ital. 59, 475; * Fl. exsicc. austro-hungar. 2368; * Linhart, Fung. hungar. 255, 454, 455.

Distrib. add: North America: United States; Minnesota, Florida, New Jersey and Nebraska (17).

South America: "Carren-leofù, Patagonia andina, Jan. 1900 (Spegazzini); Lion Range, nr. Gregory Bay, Patagonia, April 20, 1882 (Spegazzini); Santa Cruz, Patagonia, Jan. 1882 (Spegazzini); Puente de Vacas, Andibus Mendozinis, Argentine, 2,500 m. alt., Mar. 2, 1901 (Spegazzini), Paraguay.

Hosts, add: Adesmia sp., *Aesculus Hippocastanum* (18), *Alnus incana* var. *glauca*, *A. viridis*, *Amelanchier Asiatica*, *Anarthrophyllum rigidum*, *Caesalpinia sepiaria*, *Crataegus nigra* (40), *C. parvifolia*, *Desmodium* sp. (8), *Embothrium coccineum*, *Excoecaria* sp., *Fraxinus oxyphylla* (59), *Juglans* sp. (27), *Magnolia Yulan*, *Populus* sp. (27) (28), *Pyrus Malus* (34), *Quercus Kelloggii*, *Ribes Magellanicum*, *Syringa vulgaris*, *Tilia* sp. (27).

Neger (52) has described a *Phyllactinia* from South America as a new species with the following diagnosis : *P. clavariaeformis* Neger n. sp. *Ph.* hypophylla mycelio latissimo per totam matricem effuso, peritheciis numerosis, laxe confertis, globoso-depressis, 100–122 μ altis, 200–230 μ latis, verrucosis, atro-opacis, 6–9 appendicibus suffultis; appendicibus 180–350 μ longis (plerumque 200–250 μ), media longitudine interdum subincrassatis ; ascis 8–12 in quoque perithecio, ellipticis vel ovatis, apice truncatis, 62–75 μ longis, crasse stipitatis (stipite 12 μ longo, curvato), 2–4 sporis ; sporis ellipticis continuis grosse guttulatis.—Species a *Ph. suffulta* Sacc. longe recedens cellulis penicilliformibus (peritheciis insidentibus) valde ramosis, formam *clavariae* cuiusdam ramosae imitantibus. *Ph. Antarctica* Speg. periheciis appendicibusque maioribus distincta." *P. clavariaeformis* is recorded " in foliis viventibus *Ribis* (*glandulosae* R. et. P.?) ad lacum dictum Quillon rei publicae argentinae (regionis andinae) "; also on *Embothrium coccineum* from the same locality, and on *Adesmia* sp. "im Pilolilthal (Argentien, Quellgebiet des Rio Alominé)."

Neger states that he finds, from an examination of the material in the Berlin Herbarium, that the penicillate cells of the perithecia of *P. corylea* are in their unbranched part relatively short (about 30–40 μ), while in *P. clavariaeformis* this part is considerably longer (60–100 μ). The main difference, however, according to Neger, between *P. corylea* and *P. clavariaeformis* is stated thus : Man beobachtet, dass bei *Ph. guttata* [= *P. corylea*] die Pinselzellen sich unmittelbar am Scheitel in zahlreiche an der Spitze mit einem stark lichtbrechenden Knopfversehene Fäden zertheilen ; nur selten ist am Scheitel der Stielzelle eine seichte Zwei oder Dreitheilung zu beobachten. Bei *Ph. clavariaeformis* hingegen ist die Stielzelle in einer gewissen Höhe (ca. 30 bis 70 μ von der Basis entfernt) in 3, seltener 2 Aeste getheilt. Diese Verzweigung ist im entwickelten Zustand mehrfach wiederholb und überaus charakteristisch. Sie erinnert an diejenige gewisser verzweigter *Clavaria*-Arten ; die fadenartigen Ausläufer der Verzweigungen unterscheiden sich in nichts von denjenigen der *Ph. guttata*."

In order to ascertain if the characters here given were sufficiently distinctive and sufficiently constant to be of specific value, I have examined the whole of the rich material of *P. corylea*—

numbering several hundred specimens—in the Kew herbarium. The evidence obtained from the examination of these specimens (which come from all parts of the world) forces me to conclude that "*P. clavariaeformis*" is not a distinct species from *P. corylea*, and further that it is impossible to give specific value to such characters as the shape, size, etc., of the penicillate cells. The shape of the penicillate cells, in "*P. clavariaeformis*" is shown at *pl. 10, f. 1–6*, drawn from specimens (now in the Kew herbarium), on *Embothrium coccineum*, sent by Dr. Neger. Most of the cells are branched in a more or less "clavarioid" manner as described by Neger, but intermixed with these there occur not uncommonly apparently fully grown cells which are scarcely branched at all. (See *figs.*) In two specimens of the fungus called *P. Antarctica* by Spegazzini on *Ribes Magellanicum*—one from "Carren-leofù, Patagonia andina, January, 1900 (Spegazzini),"—the other (leg. P. Dusén, May, 1896) sent by Dr. Neger from Dr. Rehm's Herbarium,—the penicillate cells are formed as shown at *pl. 10, f. 10–12*. The majority of the cells show a "clavarioid" branching like that found in "*P. clavariaeformis*," and mixed among these simple or only slightly branched cells occasionally occur. In a third specimen, also on *R. Magellanicum* of "*P. Antarctica*" from "Lion Range, nr. Gregory Bay, Patagonia, April 20, 1882 (Spegazzini)"—the type locality—the penicillate cells are quite as much branched (see *pl. 10, f. 7–9*) as in "*P. clavariaeformis*," so that were the plant possessing penicillate cells with "clavarioid" branching to be kept distinct from *P. corylea*, it would have to bear the older name of *P. Antarctica* Speg. Dr. Neger writes to me that he is now of the opinion that his "*P. clavariaeformis*" is identical with "*P. Antarctica*." In a specimen labelled *P. corylea* from "Puente de Vapas, Andibus Mendozinis, 2,500 m. alt., March 2, 1901, in foliis vivis *Adesmiae* sp.," sent by Professor Spegazzini. I have found after examining some thirty or forty perithecia only unbranched penicillate cells (see *pl. 10, f. 13*). This is interesting as Neger has referred (**52**) a *Phyllactinia* on *Adesmia* sp. to "*P. clavariaeformis*." We must conclude, therefore, that on the same genus of host-plants, if not on the same species, the penicillate cells of *Phyllactinia* are sometimes simple and sometimes branched. An example on *Excoecaria* from "Paraguay, May 1883, nr. 3815" sent by Professor Spegazzini as "*P. suffulta* (Reb.) Sacc." [= *P. corylea*] is of interest from the fact that on the same perithecium we find, in about equal number, simple and branched penicillate cells (*pl. 10, f. 14–15*). [This is the plant recorded by Spegazzini, in "Fungi Guaranatici" (Anal. Soc. Cientif. Argentina, **20**: 66. 1886) as growing on *Colliguaya Brasiliensis*. This last name must therefore be expunged from the list of host-plants of *P. corylea*, as Professor Spegazzini has now written "*Excoecaria*" on the label of the specimen.]

It is, however, when we observe the variation which occurs in the shape of the penicillate cells in examples of *P. corylea* from different parts of the world that we obtain the most convincing evidence as to the worthlessness of the characters given as distinguishing "*P. clavariaeformis.*"

Taking first examples on various hosts in the United States, we find that a perfect series of intermediates exists between forms having branched or unbranched penicillate cells. In the specimens in Rav. Fung. amer. exsicc. no. 624, on *Alnus serrulata*, we find "clavarioid" branching in comparatively short cells (*pl. 10, f. 16–18*), on *Corylus Americana* similarly shaped cells occur, on *Alnus serrulata* (from South Carolina) much branched cells (*pl. 10, f. 16–18*), quite similar to those of "*P. clavariaeformis*," are found intermixed with unbranched ones; the same may be observed in the specimens in Ellis' North American Fungi, no. 1327, (*a*), on *Corylus Americana* (from Pennsylvania). Branched penicillate cells, intermixed with unbranched ones, also occur in specimens on *Carpinus Americana* (from Illinois) (see *pl. 10, f. 19*), on *Vaccinium stamineum* (from West Virginia) and on *Cornus Nuttallii* and *Quercus* (*pl. 11, f. 1*). The most remarkable North American form of *P. corylea*, however, occurs on *Catalpa syringaefolia*, from Aiken, South Carolina (Roumeg. Fung. select. exsicc. no. 4756). Here the branched stem-cell is, comparatively, extremely broad, measuring up to 35μ across (*pl. 11, f. 2–5*). If, following Neger (see above) we took such a character as the length of the stem-cell of the penicillate cells as of specific value, then we should be compelled to make another "species" of a plant possessing such remarkably shaped stem-cells as these found on the *Phyllactinia* on *Catalpa*.

Proceeding to European material we may notice first that in some specimens of *P. corylea* on *Corylus Avellana* a slight but distinct branching is found in some of the penicillate cells. I have seen this in specimens from Surrey, England (*pl. 11, f. 7*), and in the specimens in Briosi e Cavarra, Fung. par. no. 170, from Italy. Ina specimen on *Corylus Colurna* from Copenhagen most of the stem-cells are branched at the apex in the manner shown at *pl. 11, f. 8*. The same occasional branching is found in some specimens on *Alnus, e. g.*, in Fckl. Fung. Rhen. no. 704 (*pl. 11, f. 11*). The degree of branching gradually increases until we find forms like that which occasionally occurs on *Betula alba* (see *pl. 11, f. 9, 10*) from Germany in which the branching is as "clavarioid" as that found in the South American "*P. clavariaeformis*." In certain specimens occurring on *Alnus glutinosa* (see *pl. 11, f. 12, 13*) drawn from a French example we find an elongated stem-cell, up to 80 μ long, as is usually the case in *P. clavariaeformis* (*cf. pl. 9, f. 1–5*). In a specimen on *Cornus Mas* from Italy (in Sacc. Myc. Ven. no. 625), several cells branched in the manner shown at *pl. 11, f. 14*, were found on the same perithecium amongst quite simple ones.

In most Japanese examples of *P. corylea* the penicillate cells were found to be unbranched, but here, as apparently everywhere in the geographical range of the species, occasional forms occur with a "clavarioid" branching. In specimens on *Magnolia conspicua* (*M. Yulan*), we find branched and unbranched cells in about equal number on the same perithecium (see *pl. 11, f. 17–19*). In the large form of *P. corylea* on *Paulownia imperialis* (see monograph, p. 233) the stem-cell may reach to a height of 110 μ, and be either branched or unbranched. (See *pl. 11, f. 15–16*.) Distinctly branched penicillate cells also occur, intermixed with unbranched ones, on Japanese examples of *P. corylea* or *Alnus incana* var. *glauca* and on *Broussonetia papyrifera*.

We must conclude, I think, from the evidence given above, that *P. clavariaeformis* has no claims to be considered a distinct species, but that it is merely a form of *P. corylea* which appears occasionally—and certainly not confined to any definite host-plants—throughout the geographical range of this species, and that moreover it is a form which merges imperceptibly into typical *P. corylea* (*cf.* figs. on *pl. 10, 11*). Considering the peculiar shape of the penicillate cells shown by some forms we may perhaps suspect that in such variation there is to be found the origin of an incipient species—in other words that throughout the geographical range of *P. corylea* an incipient species is evolving on these lines from the parent form. The characters of this form, however, are not yet sufficiently sharply marked off, and are altogether too sporadic in appearance to allow us to give the form a place in systematic classification.

As is now well known, the apex of the perithecium of *P. corylea* is provided with a mass of penicillate cells—outgrowths from the external cells of the perithecial wall—which at a certain stage in the ripening of the perithecium and probably under certain external conditions, become mucilaginous and perform a curious function in the life history of the species. At the stage referred to the perithecium bears a large whitish mucilaginous drop on its upper surface. Neger (54) mentions that he has observed swimming about in isolated patches over the surface of this drop a foam-like mass, the separate bubbles of which bear a strong resemblance to polygonal thin-walled cells. This is evidently, as Neger observes, the structure represented by Tulasne (Carpologia, **1** : *pl. 1. f. 2, 5, 6*) as a continuous cellular membrane covering over the penicillate cells. In contact with water the cellular appearance of this mass is soon lost, and the whole disappears, leaving nothing behind but a mere trace of a hyaline mucilaginous substance. Neger states that the foam-like mass, together with the mucilaginous drop, is excreted from the perithecium. By a mechanism to be described later, the attachment of the perithecia to the leaf is destroyed, and each perithecium stands free on the points of its reflexed appendages among the hairs, etc., of the leaf, and is liable to fall at the slightest touch to the leaf or to be blown away by a breath of wind. At this stage the wall of the ultimate branches of the penicillate cells breaks down into a mucilaginous substance. When the fungus reaches a new substratum, the reflexed position of the appendages causes the apex of the perithecium, bearing its drop of mucilage, sooner or later to come into contact with the surface of the leaf, etc., on which the perithecium has fallen. The mucilage adheres to the substratum, and hardens, so that a reattachment of the perithecium, in a reversed position, takes place, and so firm is this attachment that some force is necessary to remove the perithecium with a needle. This curious phenomenon can easily be observed in nature, since on most host-plants perithecia are to be found late in the season attached to the upper surface of the leaves—a position in which they could not, in most cases, have originated, but which is to be explained by their having dropped off from the under surface of higher borne leaves, and become reattached by the mucilaginous cells. This reattachment has been the cause of leading systematists into several curious errors. In the first place there is no doubt that the numerous herbs given as hosts for *P. corylea* are not hosts in the true sense of the word at all, but are merely the plants to which perithecia, blown by the wind or fallen from the leaves of trees above, have become attached in the manner just described. Neger (**53**) records the occurrence of perithecia transferred in this way to plants of *Viola*, *Urtica*, *Onobrychis*, *Lamium*, etc., which were growing under a tree of *Corylus* attacked by *P. corylea.* Saccardo (**66**) records on *Plantago lanceolata* perithecia of *P. corylea* "evidently proceeding from leaves of trees." I have seen perithecia firmly attached to the wood of *Fraxinus* (see monograph, p. 234), and they have been recorded also on grasses and on *Pertusaria* by Bagge (see Fuckel, Symb. Myc. 80). The fungus recorded as "*Erysiphe graminis* DC.?" on the leaves and stems of *Poa nemoralis* and *Festuca sylvatica* by Richon (Cat. Champignons de la Marne, 232, 1889) with the description "Les périthèces sont ornés de 6 ou 8 appendices simples et renflés à la base. Il constitue probablement une variété de *Phyllactinia suffulta* non signalée par les anteurs et différente de l'*Erysiphe graminis* de Saccardo," may now safely be identified as *P. corylea.* "*Erysiphella Carestiana* Sacc." was founded on perithecia attached by means of their penicillate cells to the pileus of *Fomes fomentarius.* There seems also every reason to believe that the "*Erysiphe fungicola*" of Schulzer on *Boletus duriuculus* is nothing more than *P. corylea.* Hazslinszky (**27**, p. 181) gives the following description of the fungus: (I am indebted to Professor A. Mágócsy-Dietz for the translation from the Hungarian): "Perithecien zerstreut und nicht zahlreich, winzig; auf einem ausradförmig-strahlig sich verbreitenden Mycelfäden sich aufbauenden besonderen Mycelium. Asci länglich mit 1–5 Sporen. Anhängsel ähnlich denen von *Ph. guttata.* Conidien wurden bis jetzt noch nicht beobachtet. Auf verkümmerten Fruchtkörper von *Boletus* bei Vinkovce in Slavonien Königreich Ungarn." From this description we may conclude, I think, that perithecia of *P. corylea*, attached by their penicillate cells to the pileus of the *Boletus*, were under observation. In Schulzer's original diagnosis (Oest. Bot. Zeit. **26**: 58. 1876), the description occurs, "Die Pyrenien [= perithecia] sitzen, jede für sich, auf einem aus strahlenförmigen kürzeren und längeren Hyphen bestehenden Mycelium." The "mycelium" here described by both authors, probably refers as Neger (**53**) has suggested, to the spreading penicillate cells, which frequently form a membranous mycelium-like layer under the perithecium and often extend a little way beyond it.

The loosening of the perithecium from its original point of attachment is, as Neger (**54**) has pointed out, brought about by a special contrivance. The wall of the bulbiform base of the appendages is, according to Neger, thickened in all parts except in the lower quadrant nearest the perithecium (see *pl. 11, f. 20, 21*), copied from Neger. If a living perithecium (the appendages of which will be spreading horizontally more or less in the plane of the leaf on which the fungus is growing) is placed in a dry atmosphere or in a salt solution, the watery contents of the basal bulbous part of the appendage diffuse through the thin-walled part. This causes a folding to take place at this spot (see *f. 20*) and a consequent turning downward of the whole appendage, until at last the perithecium is forced away from its point of attachment and stands loose on the points of the reflexed appendages. In a damp atmosphere, or in contact with water, the bulb swells out again in the folded part, and so causes the appendages to become horizontal again. Neger observes that an appreciable force is exerted by the appendages in turning downwards in the manner described above, and mentions that a rather thick cover-glass, which was placed on four perithecia, was, in an exsiccator, easily raised up by them.

It is worth while noting that some examples of *P. corylea* on *Fraxinus excelsior* possess asci which nearly always contain three spores. This is the case, *e. g.*, with the specimens in Rabenh. Fung. Eur. 1056 (from Saxony), in which nearly all the asci are trisporous, only rarely being bi- or tetrasporous (see *pl. 9, f. 14, 15*). This fact is interesting for two reasons. In the first place, for the evidence it affords in the question of the specific worth of "*P. Candollei* Lév." (see monograph, p. 230); and, secondly, for the parallel it offers to the variation found in *Uncinula polychaeta*. This species of *Uncinula* in the United States possesses as a rule regularly bisporous asci, only very rarely showing three (or, according to Tracy and Galloway, four) spores in the ascus; in China and Japan, however, the asci are usually trisporous, but sometimes bisporous, or rarely show four or even five spores. In the case of *U. polychaeta* the form which shows an increased number of spores in the ascus is more or less definitely connected with a certain area in the geographical range of the species, while in *P. corylea* this variation occurs quite independent of locality.

P. corylea has been described as being sometimes amphigenous; I believe, however, that this is erroneous, and that its mycelium is always strictly hypophyllous. The description of the species as epiphyllous is probably due to the fact that perithecia attached by their penicillate cells occur very commonly on the upper surface of leaves, and also to the fact that an epiphyllous species of mildew may grow on the same leaf with the *Phyllactinia*. In the Kew herbarium, *e. g.*, there are leaves of a *Quercus*, from the United States, which bear on the under surface the mycelium and perithecia in all stages of development of *P. corylea*, while on the upper surface there are the mycelium and perithecia of *Microsphaera alni*, and among the mycelium perithecia of *P. corylea* attached by their penicellate cells.

Freeman (20) has recorded the occurrence of *P. corylea* on *Tilia* sp. from Minnesota, U. S. A., but the author has since written to me that this record must be expunged, the host-plant proving to be probably a species of *Cornus*.

Feltgen (18) wrongly refers the name "*Erysiphe stellata* γ *alni* Marchand to *Microsphaera alni*. Marchand (49) described his plant as follows: "*E. stellata* N. Hypophylla, filamentis plurimis, tenibus, stellato-expansis. N. β *coryli* N.—*Erysiphe coryli* Hedw. γ *alni* N.—*E alni* DC." The description given, and the synonymy quoted, show without doubt that *P. corylea* was intended.

Explanation of Plates

(All figures, unless otherwise stated, are magnified 400 times)

PLATE 9

FIG. 1. Conidial stage of *Erysiphe polygoni* DC. on *Anthriscus sylvestris*, from Reigate, England, Sept. 1900; conidiophore bearing a single conidium, and conidia.

FIG. 2. Conidial stage of *E. polygoni* DC. on *Heracleum sphondylium*, from Reigate, England, Oct. 1900, two conidiophores, each bearing a single conidium and conidia.

FIGS. 3–6. *Microsphaera euonymi* (DC.) Sacc. on *Caragana frutescens*, from Russia (in herb. Jaczewski); 3–5, apex of three appendages of the perithecium; 6, ascus and ripe ascospores.

FIG. 7. Conidia of *E. polygoni* DC. on *Sisymbrium Alliaria*, from Kew, England, Oct. 1900.

FIG. 8. Conidial stage of *E. polygoni* DC. on *Delphinium hybridum*, from Kew, England, Sept. 1900; two conidiophores, each bearing a single conidium, and conidia.

FIG. 9. Germinating conidium of *E. polygoni* DC. on *Delphinium hybridum* in a drop of water, showing the formation of an appressorium at the point where the germ-tube came in contact with the cover-glass.

FIG. 10. Apex of an appendage of the perithecium of "*Microsphaera Myoschili* Neger" (=*M. alni* (Wallr.)) on *Myoschilos oblongum*, from the Andes, Argentine Republic (ex herb. Neger.)

FIG. 11. Apex of an appendage of the perithecium of *M. alni* (Wallr.), on *Rhamnus cathartica*, from Brandenburg, Germany (Rehm. Ascomycet. no. 1117).

FIG. 12. Ascus and ripe ascospores of "*Erysiphe Fricki* Neger" (=*E. polygoni* DC.), on *Geum Chiloënse*, from the Argentine Republic (ex. herb. Neger).

FIG. 13. Lobed haustoria of *E. galeopsidis* DC. on *Tagetes minuta*, from Lincoln, Argentine Republic (ex. herb Spegazzini), × 670.

FIGS. 14, 15. Tri- and tetrasporous asci of *Phyllactinia corylea* (Pers.) Karst., on *Fraxinus Ornus*, from Saxony (Rabenh. Fung. eur. no. 1056).

FIGS. 16, 17. Apex of two (partly immature) appendages of *Microsphaera alni* (Wallr.) on *Berberis vulgaris*, from Russia (Jacz. Kom. Tranz. Fung. ross. exsicc. no. 337 b., sub *M. berberidis*).

PLATE 10

Penicillate cells of the perithecium of *Phyllactinia corylea* (Pers.) Karst., from examples from different parts of the world.

FIGS. 1–6. "*P. clavariaeformis* Neger," on *Embothrium coccineum*, from the Argentine Republic (ex herb. Neger); 6, ascus and ripe ascospores of same.

FIGS. 7–9. "*P. Antarctica* Speg.," on *Ribes Magellanicum*, from Lion Range, nr. Gregory Bay, Patagonia (ex herb. Spegazzini).

FIGS. 10–12. *P. Antarctica* Speg.," on *Ribes Magellanicum*, from Patagonia (ex herb. Dr. Rehm).

FIG. 13. On *Adesmia* sp., from the Argentine Republic (ex herb. Spegazzini).

FIGS. 14–15. On *Excoecaria* sp., from Paraguay (ex herb. Spegazzini).

FIGS. 16–18. On *Alnus serrulata*, from South Carolina, U. S. A. (Rav. Fung. amer. exsicc. no. 624, in herb. Kew).

FIG. 19. On *Carpinus Americana*, from Illinois, U. S. A. (Herb. Kew).

PLATE 11

Penicillate cells of the perithecium of *Phyllactinia corylea* (Pers.) Karst., from examples from different parts of the world.

FIG. 1. On *Quercus*, from the United States (Herb. Kew).

FIGS. 2–5. On *Catalpa syringaefolia* from South Carolina, U. S. A. (Roumeg. Fung. select. exsicc. no. 4756, in herb. Kew).

FIG. 6. On *Corylus Americana*, from Illinois, U. S. A. (Herb. Kew).

FIG. 7. On *Corylus Avellana*, from Surrey, England.

FIG. 8. On *Corylus Colurna*, from Copenhagen, (Herb. Kew).

FIGS. 9, 10. On *Betula alba*, from Germany (Herb. Kew).

FIG. 11. On *Alnus* sp. from Germany (Fckl. Fung. Rhen., no. 704, in herb. Kew).

FIGS. 12, 13. On *Alnus glutinosa*, from France (Herb. Kew).

FIG. 14. On *Cornus Mas*, from Italy (Sacc. Myc. Ven. no. 625, in herb. Kew).

FIGS. 15, 16. On *Paulownia imperialis*, from Japan (Herb. Kew).

FIGS. 17, 19. On *Magnolia Yulan*, from Japan (Herb. Kew).

FIGS. 20, 21. Bulbous base of an appendage of *P. corylea;* 20, in a turgescent condition; 21, on loss of turgescence, × 300 (from the drawing given by Neger (54, *f.* 14.

FIG 22. Ascospores from an example of *Podosphaera oxyacanthae* (DC.) de Bary, on *Crataegus Oxyacantha*, from Italy. The figures are copied from drawings made by Dr. Spegazzini on the specimen in his herbarium (see p. 84).

(To be concluded.)